PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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WRITTEN OPINION
(PCT Rule 66)

Date of mailing *(day/month/year)* 05.07.2005

Applicant's or agent's file reference
Hi-bu 031383wo

REPLY DUE **within 2 month(s)** from the above date of mailing

International application No	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 03/10269	16.09.2003	16.09.2003

International Patent Classification (IPC) or both national classification and IPC
H02J3/12

Applicant
GENERAL ELECTRIC COMPANY et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

I	☒	Basis of the opinion
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☐	Certain defects in the international application
VIII	☐	Certain observations on the international application

3 The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d)

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9

Also: For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis. For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4 The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 16.01.2006

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I. Basis of the opinion

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed")*:

Description, Pages

1-9 as originally filed

Claims, Numbers

1-6 as originally filed

Drawings, Sheets

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

6. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	
Inventive step (IS)	Claims	1-6
Industrial applicability (IA)	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Prior art

Reference is made to the following documents:

D1: US2003/0126060 A1
D2: XP10549405
D3: Jäckli,B.: Energiesparen mit Frequenzumrichter. http://www.energie.ch/themen/industrie/fr/, 1997.
D4: Bird, B. M.; King, K. G.; Pedder, D. A. G.: An Introduction to Power Electronics. Chichester, New York, Brisbane, Toronto, Singapore. John Wiley & Sons, 1993, 2nd edition, pages 85-86.

2. Clarity

Claim 1

It should be noted that the expression "in particular" has no limiting effect on the scope of the claim. The feature following any such expression is to be regarded as entirely optional (PCT International Preliminary Examination Guidelines Chapter III-4.6).

Claims 2, 3

The expression "up to at least ... x%" would mean any percentage up to x% or higher; there is neither a lower nor an upper limit for that percentage. The applicant must define the limits clear and correctly.

Claim 4

- The expression "the time interval" implies that this time interval has been defined before, which however is not the case.
- The expression "crossover" implies an intersection of the output voltage with another curve or line, which however is not further specified. It is supposed that an intersection between two consecutive output phase voltages is meant.

Claim 5

The expression "the pulse width interval" implies that this interval has been defined before,

which however is not the case. Furthermore, the wording "interval" leaves open, whether it defines the pulse width itself or the pulse width together with another not specified time interval. The former interpretation is assumed in order to proceed with the examination.

3. Inventive step

Claim 1

Claim 1 does not meet the criteria of Article 33(1) PCT, because its subject-matter seems not to involve an inventive step in the sense of Article 33(3) PCT.

Using as far as possible the wording of claim 1, document D1 discloses the following (references in the parenthesis refer to document D1):

Method for operating a frequency converter of a generator in particular of a wind energy turbine (Fig. 10; abstract: frequency converter comprises the rectifiers coupled to the wind turbines, the DC grid 1001, the inverters in the premier power facility 505, the prime mover P.M. with the rotating machine xM coupled to it), in the event of a substantial grid voltage drop (Fig. 10, 20; par. 86-105, 154, 156: in the event of a "voltage-sag" or "short-circuit", i.e. substantial grid voltage drop, xM provides short-circuit power, and therefore the frequency converter can be regarded as being operated in the event of a substantial grid voltage drop), wherein the frequency converter comprises an AC/DC converter (Fig. 10: rectifiers coupled to the wind turbines), to be connected to the generator (Fig. 10; par. 86-105), a DC/AC converter (Fig. 10: inverters in the premier power facility 505) to be connected to the voltage grid (Fig. 1: "large scale transmission grid"), and a DC link circuit for connecting the AC/DC converter to the DC/AC converter (Fig. 1: DC grid 1001).

The subject-matter of claim 1 therefore differs from document D1 in that claim 1 defines method step of

- reducing an output voltage of the DC link circuit for increasing an output current of the DC/AC converter and/or
- reducing the operation frequency of electronic switches of the DC/AC converter for increasing the output current of the DC/AC converter.

The problem to be solved by the present invention may therefore be regarded as how to ensure utility grid stability.

The solutions proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

D1, par. 105, teaches that the device xM delivers "sufficient current capacity to trip a circuit protection device" or "provides an energy storage capability that is useful during faults where voltage sags" occur. Further, from Fig. 10 in combination with par. 89 and 90, the skilled person knows that in case of a voltage sag or a short circuit the DC-grid is supplied with additional current, i.e. current is drawn from the DC link circuit to be transferred to the faulted utility grid via the device xM. The skilled person knows from his/her day-to-day practice that no DC link circuit is an infinite storage and, therefore, this extraction of current will, at least at the beginning, reduce the voltage in the DC link circuit. This, however, means that increasing an output current of the DC/AC converter, leads to an reduction of the output voltage of the DC link circuit, as defined in claim 1.

Moreover, claim 1 seems not to be inventive over the combination of D1 and D2, or D1 and D3.

Using as far as possible the wording of claim 1, document D1 discloses the following (references in the parenthesis refer to document D1):

Method for operating a frequency converter of a generator in particular of a wind energy turbine (Fig. 1; abstract), in the event of a substantial grid voltage drop, wherein the frequency converter comprises an AC/DC converter (Fig. 1: "active rectifier"), to be connected to the generator (Fig. 1: "generator A"), a DC/AC converter (Fig. 1: "inverter A") to be connected to the voltage grid (Fig. 1: "utility grid"), and a DC link circuit for connecting the AC/DC converter to the DC/AC converter (Fig. 1: capacitor between "active rectifier A" and "inverter A").

The subject-matter of claim 1 therefore differs from document D1 in that claim 1 defines method step of

- reducing an output voltage of the DC link circuit for increasing an output current of the DC/AC converter and/or
- reducing the operation frequency of electronic switches of the DC/AC converter for increasing the output current of the DC/AC converter.

The problem to be solved by the present invention may therefore be regarded as how to support the stabilization of the grid voltage on the one hand, while avoiding unduly operation of the frequency converter on the other hand.

The solutions proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

It is assumed that the skilled person would know from his/her day-to-day practice that additional current injections in a utility grid will rise the grid voltage, when that grid is suffering from over-load, because the remaining generators will be relieved. Therefore, he/she knows that in case of a fault, like a substantial grid voltage drop, additional current has to be infed into the grid by the frequency converter in order to stabilize the grid voltage again. Furthermore, the skilled person will know that every electronic device, and therefore also a frequency converter, has to be operated within its allowable thermal limits, which means that respective converter losses must not exceed certain threshold, even when the output of the current is increased. Moreover, for reasons of economy, the electronic devices will not be over designed. Confronted with the problem and taking into account the above mentioned restrictions, the skilled person would look for documents dealing with power losses of frequency converters and their influencing variables, and would find documents D2 and D3.

D2, p. 435-436, discloses the computation of the total inverter losses. Equations 1 to 4 teach that a reduced voltage across the electronic switches allows for an increased current through the switches, while keeping the total inverter losses unchanged. Moreover, D2, Fig. 1, discloses the structure of a frequency converter and immediately shows that reducing the voltage across the electronic switches means reducing the voltage U_{DC} of the DC link. Consequently, solving the problem posed by reducing the output voltage of the DC link circuit in favour of increasing an output current of the DC/AC converter in order to prohibit an unduly rise of the power losses of the frequency converter should not necessitate an inventive step for the skilled person.

Alternatively, document D3, section "Verlustleistung von Frequenzumrichtern", computes the power losses "P_{VU}" in dependence of the current IM and the switching frequency f_{PWM} of a frequency converter. That teaches that for given power losses, the converter current IM can be increased if the switching frequency f_{PWM} (= operation frequency of the electronic

switches) is reduced at the same time.

The indications provided by the prior art seem to be sufficient to prompt the skilled person, namely when the above mentioned problem is to be solved, to

- reduce the output voltage of the DC link circuit and/or
- reduce the operation frequency of the electronic switches of the DC/AC converter in the frequency converter of D1, Fig. 1,

in order to increase an output current of its DC/AC converter, while keeping the power losses constant, without executing an inventive step.

Claims 2, 3

Dependent claims 2 and 3 seems not to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, for the following reason:
Claims 2 and 3 seem to define merely the voltage levels where increased current injection is started or stopped. Postulating these results should be the result of a routine trial and error work without executing an inventive step (PCT International Preliminary Examination Guidelines Chapter IV-8.8 (C1)(ii)).

Claim 4

Dependent claim 4 seems not to contain any features which, in combination with the features of any claim to which it refers, meets the requirements of the PCT in respect of inventive step, for the following reason:
Claim 4 seems to define the firing control mechanism of an AC/DC converter. D4, Fig. 2.41, discloses a AC/DC converter with thyristors. Fig. 2.42 teaches that the crossovers between the AC phase voltages (see diagrams v_{phs}), which can be regarded as output voltages of a generator, mark the reference point, i.e. "crossover", of the firing angle alpha. The firing angle alpha is the time interval, after which the thyristor is fired in order to receive a desired DC voltage.

Claim 5

Dependent claim 5 seems not to contain any features which, in combination with the features of any claim to which it refers, meets the requirements of the PCT in respect of inventive step, for the following reason:
D4, Fig. 2.42, shows sawtooth-like pulses of an output voltage v_d of a AC/DC converter.

The lower the DC output voltage v_d, the smaller the sawtooth-like pulses and therefore the corresponding pulse widths must be.

Moreover, it seems to be part of common knowledge that in an AC/DC converter zero pulse width leads to zero output voltage, while increasing the pulse width leads to increasing the output voltage, respectively.

Claim 6

Dependent claim 6 seems not to contain any features which, in combination with the features of any claim to which it refers, meets the requirements of the PCT in respect of inventive step, for the reasons given already for claim 1 in combination with D2 or D3, respectively.

4. Industrial applicability

The industrial applicability in the sense of Art. 33(4) PCT is given for the claims 1-6.